performance of the wiresaw. The creation of hydrogen can also be hazardous in a manufacturing environment (e.g., as an explosion hazard).

[0006] Accordingly, it would be advantageous to formulate an aqueous wiresaw cutting fluid composition that limits the amount of hydrogen created during a wiresaw cutting process. The compositions of the present invention fulfill this need.

BRIEF SUMMARY OF THE INVENTION

[0007] The present disclosure~~invention~~ provides an aqueous wiresaw cutting fluid composition that reduces the amount of hydrogen produced when cutting water-reactive work pieces such as silicon during a wiresaw cutting process. The composition comprises an aqueous carrier, a particulate abrasive, a thickening agent, and a hydrogen suppression agent. The abrasive, the thickening agent, and the hydrogen suppressing agent are each separate and distinct components of the cutting fluid compositions of the present invention, as is the aqueous carrier; although, each of these components may have more than one function or provide more than one benefit to the wiresaw cutting performance of the composition.

[0008] While not wishing to be bound by theory, it is believed that the hydrogen suppressing agent reacts with molecular hydrogen to trap the gas or chemically react with the hydrogen gas thereby reducing the amount of free hydrogen gas that is present in the composition. Suitable hydrogen suppressing agents include hydrophilic polymers, surfactants, silicone, and hydrogen scavengers.

[0009] One embodiment of the present disclosure~~invention~~ is an aqueous wiresaw cutting fluid composition. Included in this composition is an aqueous carrier containing a thickening agent, a particulate abrasive, and a hydrogen suppressing agent. The hydrogen suppression agent is selected from a group consisting of a hydrophilic polymer, a surfactant having a hydrophobic portion comprising at least 6 carbon atoms in a chain, a silicone, and a hydrogen scavenger.

[0010] Another embodiment of the present disclosure~~invention~~ is an aqueous wiresaw cutting fluid composition comprising a particulate abrasive, an aqueous carrier, a thickening agent, and at least one hydrogen suppressing agent selected from the group consisting of a surfactant, a hydrogen-reactive metal compound, a silicon-reactive metal compound, a hydrosilylation catalyst, and an organic electron transfer agent. The surfactant comprises a hydrophobic portion and a hydrophilic portion. The hydrophobic portion of the surfactant comprises one or more of a substituted hydrocarbon group, a non-substituted hydrocarbon

group, and a silicone group. The hydrophilic portion of the surfactant comprises one or more of a polyoxyalkylene group, an ether group, an alcohol group, an amino group, a salt of an amino group, an acidic group, and a salt of an acidic group.

[0011] Another embodiment of the present disclosure~~invention~~ is an aqueous wiresaw cutting fluid composition comprising an aqueous carrier containing a thickening agent, a particulate abrasive, and a hydrogen suppressing agent selected from a nonionic surfactant having an HLB of 18 or less, and a hydrophilic polymer having an HLB of 18 or less.

[0012] According to additional teachings of the present disclosure~~invention~~, hydrogen generation in a wire saw cutting process is ameliorated by utilizing an aqueous wiresaw cutting fluid of the type taught herein while cutting a workpiece with a wiresaw.

[0013] In certain preferred embodiments of the present disclosure~~invention~~, the composition has an acidic pH. While not wishing to be bound by theory, it is believed that decreasing the pH of the composition decreases the rate of any oxidation reaction that might occur between water and the material being cut during the wiresaw process. Reducing the rate of the oxidation reaction reduces the amount of hydrogen that is produced by such a reaction. In other particularly preferred embodiments, the cutting fluid composition comprises a combination of a surfactant and a hydrophilic polymer, a combination of a surfactant and a silicone, or a combination of a surfactant, a hydrophilic polymer, and a silicone as the hydrogen suppressing agent.

[0013a] In one aspect, there is provided an aqueous wiresaw cutting fluid composition comprising: a particulate abrasive; an aqueous carrier containing a thickening agent; and at least one hydrogen scavenger; wherein the abrasive, the thickening agent and the hydrogen scavenger are separate and distinct components of the composition, and wherein the hydrogen scavenger is contained in the composition in an amount of 0.01 to 4 percent by weight.

[0013b] In another aspect, there is provided an aqueous wiresaw cutting fluid composition comprising a particulate abrasive; an aqueous carrier; a thickening agent; and at least one hydrogen scavenger selected from the group consisting of a hydrogen-reactive metal compound, a silicon-reactive metal compound, a hydrosilylation catalyst, and an organic electron transfer agent; wherein the abrasive, the thickening agent and the hydrogen scavenger are separate and distinct components of the composition, and wherein the hydrogen scavenger is contained in the composition in an amount of 0.01 to 4 percent by weight.

[0013c] In yet another aspect, there is provided a method of ameliorating hydrogen generation in a wiresaw cutting process utilizing an aqueous wiresaw cutting fluid, the method comprising cutting a workpiece with the wiresaw and an aqueous cutting fluid composition as defined above.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The compositions of the present invention each contain an aqueous carrier such as water, an aqueous glycol and/or an aqueous alcohol. Preferably, the aqueous carrier predominately comprises water. The aqueous carrier preferably comprises 1 to 99 percent of the composition by weight, more preferably 50 to 99 percent by weight. Water preferably comprises 65 to 99 percent by weight of the carrier, more preferably 80 to 98 percent by weight.

[0015] The compositions of the present invention also each contain a particulate abrasive such as silicon carbide, diamond, or boron carbide. The particulate abrasive typically comprises 1 to 60 percent by weight of the composition. In some embodiments, the particulate abrasive comprises particulate diamond present at a concentration of 1 to 10 percent by weight. In another embodiment when the abrasive is not diamond it is preferred

CLAIMS

1. An aqueous wiresaw cutting fluid composition comprising:

a particulate abrasive;

an aqueous carrier containing a thickening agent; and

at least one hydrogen suppressing agent selected from the group consisting of a hydrophilic polymer, a surfactant having a hydrophobic portion comprising at least 6 carbon atoms in a chain, a silicone, and a hydrogen scavenger;

wherein the abrasive, the thickening agent and the hydrogen suppressing agent are separate and distinct components of the composition.

2. The composition of claim 1, wherein the at least one hydrogen suppressing agent is the surfactant having a hydrophobic portion comprising at least 6 carbon atoms in a chain, wherein the surfactant has an HLB of 18 or less.

3. The composition of claim 1, wherein the at least one hydrogen suppressing agent is the hydrophilic polymer, wherein the polymer has an HLB of 18 or less.

4. The composition of claim 1 wherein the thickening agent comprises a cellulose compound.

5. The composition of claim 1 wherein the thickening agent provides a viscosity of at least 40cP to the carrier.

6. The composition of claim 1 wherein the thickening agent is present at a concentration in the range of about 0.2 to 10 percent by weight.

7. The composition of claim 1 wherein the abrasive comprises silicon carbide, diamond or boron carbide.

8. The composition of claim 1 comprising at least two hydrogen suppressing agents.

9. The composition of claim 1 wherein the abrasive is present at a concentration in the range of 30 to 60 percent by weight.

10. The composition of claim 1 wherein the surfactant is selected from the group consisting of an aryl alkoxylate, an alkyl alkoxylate, an alkoxylated silicone, an acetylenic alcohol, an ethoxylated acetylenic diol, a C_8 to C_{22} alkyl sulfate ester, C_8 to C_{22} alkyl phosphate ester, C_8 to C_{22} alcohol, and an alkyl ester.

11. The composition of claim 1 wherein the composition comprises about 0.01 to 4 percent by weight of a silicone.

12. The composition of claim 1 further comprising about 0.01 to 4 percent by weight of an oxidizing agent.

13. The composition of claim 1 wherein the composition comprises about 0.01 to 4 percent by weight of the hydrogen scavenger.

14. The composition of claim 13 wherein the hydrogen scavenger is selected from the group consisting of a hydrogen reactive metal compound, a hydrosilylation catalyst, an organic electron-transfer agent, and a silicon reactive metal compound.

15. An aqueous wiresaw cutting fluid composition comprising

a particulate abrasive;

an aqueous carrier;

a thickening agent; and

at least one hydrogen suppressing agent selected from the group consisting of a surfactant, a hydrogen-reactive metal compound, a silicon-reactive metal compound, a hydrosilylation catalyst, and an organic electron transfer agent;

wherein the surfactant comprises a hydrophobic portion and a hydrophilic portion; the hydrophobic portion of the surfactant comprising one or more of a substituted hydrocarbon group, a non-substituted hydrocarbon group, and a silicone group; and the hydrophilic portion of the surfactant comprises one or more of a polyoxyalkylene group, an ether group, an alcohol group, an amino group, a salt of an amino group, an acidic group, and a salt of an acidic group, and wherein the abrasive, the thickening agent and the hydrogen suppressing agent are separate and distinct components of the composition.

16. The composition of claim 15 wherein the abrasive comprises silicon carbide, diamond or boron carbide.

17. The composition of claim 15 wherein the hydrophilic portion of the surfactant comprises one or more ether groups .

18. The composition of claim 15 wherein the abrasive is present at a concentration in the range of 30 to 60 percent by weight.

19. A method of ameliorating hydrogen generation in a wiresaw cutting process utilizing an aqueous wiresaw cutting fluid, the method comprising cutting a workpiece with the wiresaw and an aqueous cutting fluid composition of claim 1.

20. The method of claim 19 wherein the workpiece comprises silicon.

What is claimed is:

1. An aqueous wiresaw cutting fluid composition comprising:
a particulate abrasive;
an aqueous carrier containing a thickening agent; and
at least one hydrogen scavenger;
wherein the abrasive, the thickening agent and the hydrogen scavenger are separate and distinct components of the composition, and wherein the hydrogen scavenger is contained in the composition in an amount of 0.01 to 4 percent by weight.

2. The composition of claim 1 wherein the thickening agent comprises a cellulose compound.

3. The composition of claim 1 wherein the thickening agent provides a viscosity of at least 40cP to the carrier.

4. The composition of claim 1 wherein the thickening agent is present at a concentration in the range of about 0.2 to 10 percent by weight.

5. The composition of claim 1 wherein the abrasive comprises silicon carbide, diamond or boron carbide.

6. The composition of claim 1 comprising at least two hydrogen scavengers.

7. The composition of claim 1 wherein the abrasive is present at a concentration in the range of 30 to 60 percent by weight.

8. The composition of claim 1 further comprising about 0.01 to 4 percent by weight of an oxidizing agent.

9. The composition of claim 1 wherein the hydrogen scavenger is selected from the group consisting of a hydrogen reactive metal compound, a hydrosilylation catalyst, an organic electron-transfer agent, and a silicon reactive metal compound.

10. An aqueous wiresaw cutting fluid composition comprising
a particulate abrasive;
an aqueous carrier;
a thickening agent; and
at least one hydrogen scavenger selected from the group consisting of a hydrogen-reactive metal compound, a silicon-reactive metal compound, a hydrosilylation catalyst, and an organic electron transfer agent;
wherein the abrasive, the thickening agent and the hydrogen scavenger are separate and distinct components of the composition, and wherein the hydrogen scavenger is contained in the composition in an amount of 0.01 to 4 percent by weight.

11. The composition of claim 10 wherein the abrasive comprises silicon carbide, diamond or boron carbide.

12. The composition of claim 10 wherein the abrasive is present at a concentration in the range of 30 to 60 percent by weight.

13. A method of ameliorating hydrogen generation in a wiresaw cutting process utilizing an aqueous wiresaw cutting fluid, the method comprising cutting a workpiece with the wiresaw and an aqueous cutting fluid composition of claim 1.

14. The method of claim 13 wherein the workpiece comprises silicon.